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CONTRIBUTIONS

TO

THE MINERALOGY OF NOVA SCOTIA

BY

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IV. *Lignite—Semibituminous Coal—Cannel Coal—Turgite—Delessite—Fahlunite—Silicoborocalcite.*

LIGNITE.—In the eastern part of the province there are found in the carboniferous districts, but apart from the beds of coal, sulphides of metals associated with coaly matter having the characters of lignite. The sulphides are relatively large in quantity, and frequently consist of iron and copper pyrites, with a very rich sulphide of copper, apparently vitreous, though called grey. The enclosing rock of such specimens of these copper ores as I have seen is sandstone, and it is generally more or less impregnated with green carbonate. In one instance galena occurs with iron pyrites in a conglomerate of limestone and siliceous pebbles. The masses composed of the carbonaceous and metallic minerals generally exhibit the form of branches and trunks of trees; and Dr. Dawson points out* that those containing copper result from the action of vegetable matter on waters containing sulphate of the metal. The formation of

* Acadian Geology, p. 327.

galena would involve some secondary action. The deposits are not thought to be of mining-importance, except in two instances, in which the ores of copper are considered to exist in promising quantities: in one of these, indeed, lately discovered there is said to be a bed some feet thick; a sample of the ore sent me gave 29·5 per cent. metallic copper.

I have not been able to find more than one complete ultimate analysis of a lignite; this is one of the fourteen analyses given by Dana*. In a minority only of the others is the existence of nitrogen mentioned; the quantity is given in no case but that referred to, the analysis of Vaux, who found 0·57 per cent. From this result and the following ultimate analysis of a lignite from one of the deposits above mentioned, for which I am indebted to Professor Anderson of Glasgow, it appears that the quantity of nitrogen is somewhat less in this mineral than in black coal.

The lignite selected for examination occurs in the carboniferous district of Pictou county, with copper ore and common iron pyrites. It is nearly black, and retains on some faces a fine-grained woody structure, not very obvious to the naked eye, but distinct under a glass: these surfaces are dull; those at right or oblique angles are black, of almost resinous lustre, and without structure: it is sectile, and easily broken into angular fragments which receive polish under the burnisher. The mineral evidently belongs to the variety of brown coal called jet. Boiled in potash, it scarcely colours the fluid. Ignited, it gives a transient feeble yellow flame, and afterwards glows for a considerable time, evolving the greasy odour often observed with lignite; in a closed tube the product is chiefly water with a little yellowish matter; the vapours have an alkaline reaction. Ultimate analysis gave:—

Carbon	74·5
Hydrogen	4·3
Nitrogen	1·0
Oxygen	18·7
Ash	1·5
	100·0

It does not appear that any inquiry has been made as to whether lignites vary in composition according to their geological age. As the circumstances under which they were formed must have been analogous, the only differences to be expected at the corresponding stages of conversion are those depending on variations in the original material. Hence nothing like strict comparison can be made; the following, however, is not without interest. The large deposits of brown coal found in Germany

* Mineralogy, 5th edit. p. 758.

are of tertiary age; and Liebig has shown* that there is a notable difference among these in chemical composition. The more complete the obliteration of the woody structure, the greater the departure from the relative proportions of the organic elements in the original material. The wood-coal from Ringkuhl, near Cassel, is seldom found with the structure of wood, and is therefore more comparable with the Pictou lignite than any in which this is retained; its composition is given as—

Carbon	63·83
Hydrogen . . .	4·80
Oxygen	25·51
Ash	5·86
	100·00

and the approximate formula (old notation)

$$C^{32}\,H^{15}\,O^{9}$$

is added as deduced from these numbers: for comparison' sake I have calculated a corresponding approximate formula from the analysis of the Pictou lignite; it is

$$C^{32}\,H^{12}\,O^{8}.$$

Hence, as compared with wood, for which Liebig gives the formula

$$C^{36}\,H^{22}\,O^{12},$$

there is a further loss of one atom of water and two atoms of hydrogen, marking the difference between the carboniferous and the tertiary lignites in question.

As I have before pointed out†, the true ratio of carbon to hydrogen, in such minerals as contain these elements together with oxygen, is only brought out after deducting the amount of hydrogen equal to that of the latter element present. In the case of the two lignites just spoken of, the ratio stands thus:—

	Pictou.	Ringkuhl.
Ratio of C to H without deducting H=O present	100 : 5·77	100 : 7·52
Ratio of C to H after deducting H=O present	100 : 2·63	100 : 2·50

The effect of this deduction is obvious enough; at the same time a very close accordance is exhibited in the ratio between the remaining elements. How much this differs from that existing in bituminous coals is seen by the following comparisons. While numerous coals of the province have been submitted to ~~prismatic~~ proximate

* Agricultural Chemistry, 4th American edit. p. 368 *et seq.*

† Mineralogy of Nova Scotia, p. 25.

analysis*, one only has had its ultimate composition determined, that, namely, found at Springhill, Cumberland county. All the true coals of the province are bituminous, and they would, no doubt, give results comparable with those from the Springhill coal below and the bituminous coals now selected as representatives from among those analyzed by myself during the British Admiralty Coal-Inquiry†.

Bituminous coals.		Percentages.			Ratio of carbon to hydrogen.		Authority.
		Carbon.	Hydrogen.	Oxygen.	By analysis.	On deducting H=O.	
Nova-Scotian.	Springhill. Cumb. co.	72·00	5·02	7·26	100 : 6·97	100 : 5·72	Woodhouse & Jeffcocke
Welsh.	Duffryn	88·26	4·66	0·60	100 : 5·28	100 : 5·18	H. How.
	Newydd	84·71	5·76	3·52	100 : 6·79	100 : 6·28	,,
	Ebbw Vale ...	89·78	5·15	0·39	100 : 5·73	100 : 5·67	,,
cotch.	Grangemouth.	79·85	5·28	8·58	100 : 6·61	100 : 5·27	,,
	Fordel	79·58	5·50	8·38	100 : 6·93	100 : 5·73	,,
English.	Broom Hill ...	81·70	6·17	4·37	100 : 7·55	100 : 6·88	,,
	Lydney	73·52	5·69	6·48	100 : 7·73	100 : 6·63	,,

Semibituminous Coal.—On the line of railway between Truro and Pictou, about twenty miles from the former town, a curious "vein" is found between slaty walls, consisting of black lustrous mineral formed into a sort of network by the intersection of numerous cross veins of fibrous ferriferous carbonate of lime, the whole being two or three inches thick. The black mineral looks something like graphite, is rather hard, H.=2·5, and very brittle; ignited, it gives a luminous white flame, exfoliates, smells strongly of sulphurous acid, and burns with some difficulty to a reddish ash. In a closed tube it does not melt, scarcely changes its form, gives but a small quantity of smoke and oil; the fumes are very acid. For the carbon- and hydrogen-determinations which follow I am indebted to Professor Anderson. Ultimate analysis gave:—

Carbon	85·33
Hydrogen	4·99
Sulphur, nitrogen, and oxygen .	4·70
Ash	4·98
	100·00

Proximate analysis afforded me:—

Volatile matters . . .	10·90
Residue, or "coke" . .	89·10
	100·00

* *Loc. cit.* p. 33, and Dawson's 'Acadian Geology.'

† First Parliamentary Report by Delabeche and Playfair.

The residue, or "coke," consisted of a powder unchanged in appearance from that put into the crucible.

The foregoing results indicate a semibituminous coal: the mineral differs widely from the bedded coals of the province, which, as before mentioned, are bituminous; some, indeed, are so in rather a high degree. The mode of occurrence of this coal (the only one I have met with here approaching anthracite) is curious, and worth further investigation.

Cannel Coal.—A specimen "from an 18-inch seam at Little Glace Bay, Cape Breton," had the appearance of cannel coal, gave a brown powder and a brownish-black streak, burned alone when well heated in a flame, in a closed tube gave much volatile matter, and left a rounded swollen coke. Proximate analysis gave me:—

Moisture	0·83
Volatile combustible matter .	30·07
Fixed carbon	44·42
Ash	24·68
	100·00

The amount of ash here, though considerable, is smaller than that in the well-known Scotch cannel from Capeldrae, which gives, according to Fyfe, 25·40 per cent. The volatile combustible matter is evidently high enough, in proportion to the fixed carbon, to mark the class of minerals to which the specimen belongs. This is the first example of Nova Scotian cannel coal yet examined, unless, as would be right according to some authorities, now perhaps diminishing in number, the remarkably rich oil-coal which I have called stellarite * is made to belong to the class.

Turgite.—This well-defined species may be recorded among the minerals of iron met with in the province. It occurs with brown hæmatite at Terry Cope, and at another locality, probably in the same county of Hants, according to my own examination of specimens sent me, and it will doubtless be found frequently elsewhere in the same association. Both the specimens in question afforded red powder, gave water on ignition, and decrepitated violently in the forceps before the blowpipe. The mineral from the last-mentioned locality was mixed with siliceous and calcareous matters; when these were deducted, the constituents of the air-dried substance were:—

Water	5·51
Peroxide of iron . . .	94·49
	100·00

The formula of turgite, $2Fe^2O^3 + HO$, requires 5·32 per

* Mineralogy of Nova Scotia, p. 24.

cent. water; hence there can be no doubt as to the nature of the species.

Delessite?—There are frequently seen in the amygdaloidal traps of the western part of the province masses of a soft, dark green, chlorite-like mineral; or perhaps there are more species than one having these characters, sometimes filling rock-cavities more or less completely, and occasionally coating or partly composing zeolites, as, for example, analcime, which in different localities has its colour thus made to vary through all shades to dark green. At one place, Two Islands, in the Basin of Minas, I observed, several years ago, large crystals of this species lying loose in a cavity of the trap above high-water mark, like specimens on the shelf of a cabinet. I could not get as many of these as I wished, nor examine the nature of the cavity, on account of the rapidly rising tide. Some of the crystals were colourless; one was most curiously composed: nearly half of the upper portion consisted of white partly transparent analcime; the rest, including the whole base, was almost entirely made up of a soft dark-green mineral like chlorite. The crystal had the form of analcime; it was about an inch and a quarter in diameter. I made no analysis of the green mineral in this case; but I examined a specimen of similar soft, green, greasy-looking mineral from cavities of trap on the Bay of Fundy. It was very dark in colour, opaque to the naked eye, translucent under the microscope, very soft, fusible on the edges to a black glassy bead before the blowpipe. It dissolved partially in slightly warmed hydrochloric acid, to which it gave both protoxide and peroxide of iron in large quantity. Water was lost on ignition and was so estimated; the amount obtained in this way, however, would be rather below the truth, owing to the absorption of oxygen by the protoxide of iron. Alkalies were not sought for. Analysis of the air-dried mineral gave:—

Silica	40·53
Metallic iron	12·50
Alumina	6·95
Lime	0·52
Magnesia	14·15
Gangue	2·87
Water (by ignition) . .	13·10
Oxygen and loss . . .	9·38
	100·00

These results appear to place the mineral between Delessite and epichlorite, which have the following composition*:—

* Dana's 'Mineralogy,' 5th edit. pp. 493, 497.

	Epichlorite.	Delessite from Mielen.
Silica	40·88	31·07
Alumina	10·96	15·47
Peroxide of iron .	8·72	17·54
Protoxide of iron .	8·96	4·07
Magnesia . . .	20·00	19·14
Lime	0·68	0·46
Water	10·18	11·55
	100·38	99·30

As epichlorite occurs in veins in serpentine, and Delessite is found coating and filling the cavities of amygdaloid, the mineral now described is probably the latter, perhaps mixed with some free silica.

Fahlunite.—On the road between Windsor and Chester granite is found, at some point not mentioned to me, containing crystals which present the characters of chlorophyllite, or one of the varieties of Fahlunite. They are many- (perhaps 12-)sided prisms, sometimes half an inch across, greenish brown and dull externally; the distinct basal cleavage shows faces of a grey colour and vitreous lustre; weathered surfaces of this kind have the appearance of mica; hardness of the fresh faces about 3; streak grey and earthy. The mineral fuses before the blowpipe on the edges to a black slag, yields a little water on ignition, gives abundance of protoxide of iron to cold hydrochloric acid on standing for some time, and a very small quantity of peroxide; by fusion with alkaline carbonate its other constituents are found to be silica, alumina, manganese, a trace of lime, and a little magnesia. I made no quantitative analysis; but it is evident the mineral belongs to the species Fahlunite, which results from the alteration of iolite*.

Silicoborocalcite in a new locality.—It is an interesting fact that this new mineral, which was first described in the last part of these "Contributions"†, and which Dana has since called Howlite‡, has recently been found in gypsum in a new locality some thirty or forty miles N.E. of Brookville near Windsor, whence it was first obtained. The quantity is said to be by no means inconsiderable; and as I have shown§ that the mineral will probably admit of a special application, just as it occurs, in enamelling iron, it may prove to be a valuable addition to the already large and varied mineral resources of the province. The specimen by which I identified the species recently found was in

* Dana's 'Mineralogy,' 5th edit. p. 484.
† Phil. Mag. Jan. 1868.
‡ Mineralogy, 5th edit. p. 598.
§ Mineralogy of Nova Scotia, p. 141.

the powdery form described in the paper referred to above. The mineral is reported to be most abundant in a "black band" of gypsum, and to be met with in nodules which are sometimes very much larger than any seen by myself near Windsor; a good deal is said to have been thrown away by the quarrymen as being of no value compared with the plaster; this is worth about 90 cents a ton, shipped, while the borate would probably realize nearly as many dollars, or, roughly, be a hundred times as valuable. It was mentioned in the paper already twice alluded to, that, from what I had observed, the lowest beds of gypsum would probably afford the largest quantity of this mineral and its fellow borate: the new locality, as I understand, is one of those where the lowest members of the carboniferous series containing beds of gypsum are found.